Stoller
Hanford Office

DOE-EM/GJ707-2004

# 299-E25-6 (A4796)
## Log Data Report

## Borehole Information:

| **Borehole:** 299-E25-6 (A4796) | | | **Site:** 216-A-8 Crib | | |
|---|---|---|---|---|---|
| **Coordinates** (WA State Plane) | | **GWL (ft)[1]:** 263.7 | | **GWL Date:** | 07/07/2004 |
| **North** | **East** | **Drill Date** | **TOC[2] Elevation** | **Total Depth (ft)** | **Type** |
| 136,163.971 m | 575,683.761 m | April 1956 | 202.603 m | 290 | Cable Tool |

## Casing Information:

| Casing Type | Stickup (ft) | Outer Diameter (in.) | Inside Diameter (in.) | Thickness (in.) | Top (ft) | Bottom (ft) |
|---|---|---|---|---|---|---|
| Welded steel | +2.4 | 6 5/8 | 6 1/8 | 1/4 | +2.40 | 229 |
| Welded steel | 0 | 8 | unknown | unknown | | 290 |
| The logging engineer used a caliper to determine the outside casing diameter. The caliper and casing stickup were both measured using a steel tape. Inside casing diameter was measured with a steel tape. All measurements were rounded to the nearest 1/16 in. Bottom is reported from *Hanford Wells* (Chamness and Merz 1993). The 8-in. casing was not observed at the ground surface. | | | | | | |

## Borehole Notes:

Borehole coordinates, elevation, and well construction information are from measurements by Stoller field personnel, HWIS[3], and Ledgerwood (1993). Zero reference is the top of the 6-in. casing. Before logging began, Duratek well services removed a pump and rods from the borehole.

## Logging Equipment Information:

| **Logging System:** | Gamma 2A | | **Type:** | 35% HPGe (34TP20893A) |
|---|---|---|---|---|
| **Calibration Date:** | 03/2004 | **Calibration Reference:** | DOE-EM/GJ642-2004 | |
| | | **Logging Procedure:** | MAC-HGLP 1.6.5, Rev. 0 | |

## Spectral Gamma Logging System (SGLS) Log Run Information:

| Log Run | 1 | 2 | 3 | 4 | 5 / Repeat |
|---|---|---|---|---|---|
| Date | 07/01/04 | 07/06/04 | 07/07/04 | 07/08/04 | 07/08/04 |
| Logging Engineer | Spatz | Spatz | Spatz | Spatz | Spatz |
| Start Depth (ft) | 26.0 | 80.0 | 263.0 | 156.0 | 78.0 |
| Finish Depth (ft) | 3.0 | 25.0 | 155.0 | 79.0 | 52.0 |
| Count Time (sec) | 200 | 200 | 200 | 200 | 200 |
| Live/Real | R | R | R | R | R |
| Shield (Y/N) | N/A[4] | N/A | N/A | N/A | N/A |
| MSA Interval (ft) | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| ft/min | N/A | N/A | N/A | N/A | N/A |
| Pre-Verification | BA358CAB | BA360CAB | BA361CAB | BA362CAB | BA362CAB |

| Log Run | 1 | 2 | 3 | 4 | 5 / Repeat |
|---|---|---|---|---|---|
| Start File | BA359000 | BA360000 | BA361000 | BA362000 | BA362078 |
| Finish File | BA359023 | BA360055 | BA361108 | BA362077 | BA362104 |
| Post-Verification | BA359CAA | BA360CAA | BA361CAA | BA362CAA | BA362CAA |
| Depth Return Error (in.) | 0 | 0 | + 1/2 | N/A | 0 |
| Comments | Before logging began a fine gain adjustment was made. | No fine gain adjustment made. | Fine gain adjustment made after files -013, -053, and -098. | Fine gain adjustment made after files -012, -042, -057, and -069. | Fine gain adjustment made after file -091. |

## Logging Operation Notes:

Zero reference was top of the 6-in. casing. Logging was performed without the centralizer on the sonde for spectral data collected between 263 and 155 ft. Pre- and post-survey verification measurements for the SGLS employed the Amersham KUT ($^{40}$K, $^{238}$U, and $^{232}$Th) verifier with serial number 082.

## Analysis Notes:

| Analyst: | McCain | Date: | 08/11/04 | Reference: | GJO-HGLP 1.6.3, Rev. 0 |
|---|---|---|---|---|---|

SGLS pre-run and post-run verification spectra were collected at the beginning and end of each day. Net count rates for the 609-keV and 1461-keV gamma lines were within verification criteria, but net count rates for the 2614-keV gamma line were below the acceptance criteria in 4 of 8 verification spectra. All results were within the HASQARD 20% limits. Peak width (fwhm) values tended to be above the verification criteria, particularly for the 2614-keV gamma line. Examination of the individual spectra indicated the system appears to be functioning normally, and the spectra are provisionally accepted.

Log spectra for the SGLS were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Pre-run verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: G2AMar04.xls), using parameters determined from analysis of recent calibration data. Zero reference was the top of the 6-in. casing. The casing configuration was assumed to consist of an 8-inch casing from the ground surface to 290 ft, with a 6-inch casing inside the 8-inch casing to a depth of 229 ft. Casing thickness values are published values for ASTM schedule-40 steel pipe. A total casing thickness of 0.602 in. (0.280 + 0.322) was used from the ground surface to 229 ft, and 0.322 was used from 229 ft to 290 ft. The maximum log depth was 263 ft. The well construction and completion summary indicates the 8-inch casing was perforated from 0 to 5 ft and 20 to 224 ft and that the annular space between the 6-inch casing and 8-inch casing was filled with cement grout. No correction was applied for the grout, and it is likely that concentration values are slightly underestimated above 224 ft.

## Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides ($^{40}$K, $^{238}$U, and $^{232}$Th), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The $^{214}$Bi peak at 1764 keV was used to determine the naturally occurring $^{238}$U concentrations on the combination plot rather than the $^{214}$Bi peak at 609 keV because it exhibited slightly higher net counts per second.

## Results and Interpretations:

$^{137}$Cs was the only man-made radionuclide detected in this borehole. $^{137}$Cs was detected in three intervals: (1) between 9- and 11-ft depth, with a maximum concentration of 9.8 pCi/g; (2) between 22 and 73 ft, with a maximum concentration of 50 pCi/g at 25 to 30 ft, gradually decreasing to the MDL of about 0.25 to 0.30 pCi/g at 73 ft; and (3) between 227 and 234 ft, with a maximum concentration of 3.2 pCi/g. $^{137}$Cs was also detected sporadically at or near the MDL (0.3 pCi/g) at 138 ft, 212 ft, and 243 to 250 ft.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS data for the natural radionuclides (609, 1461, 1764, and 2614 keV) and $^{137}$Cs.

Plots comparing RLS data from August 1990 to SGLS data are also provided. The RLS $^{137}$Cs values have been corrected to account for differences in casing thickness assumptions and decayed to July 2004. The corrected 1990 values are significantly lower than the 2004 values. However, both log curves reflect a similar contaminant profile. The apparent discrepancy in $^{137}$Cs values is most likely due to differences in system calibration assumptions.

Gross gamma logs digitized from Additon et al. (1977) are also shown. These logs were converted to counts per second versus depth in feet for better comparison with RLS and SGLS data. As early as 1958, a zone of high gamma activity is observed from approximately 15- to 60-ft depth. Within this interval, the detector appears to be saturated. The 1958 and 1959 logs show abrupt increases in gamma activity at the bottom of the logged interval at 230 to 240 ft. This may indicate contamination at or near groundwater level. By 1963, the interval of detector saturation extends to about 105 ft. Gamma activity levels have increased significantly between 105 and 135 ft, and there appears to be an abrupt decrease at 135 ft, suggesting additional contamination events and/or downward contaminant migration between 1959 and 1963. The 1968 and 1976 logs show significantly lower gamma activity levels and generally reflect the profile of the 1990 RAS and 2004 SGLS logs. Below 40- to 60-ft depth, the dominant contaminant may have been a radionuclide with a relatively short half life, such as $^{106}$Ru.

The 1976 log shows significantly greater gamma activity between approximately 20 to 75 ft. This may indicate an additional contamination event between 1968 and 1976.

The SGLS $^{137}$Cs log indicates contaminant migration to a depth of 74 ft. The historical data suggest contaminants from the 216-A-8 Crib reached at least 135-ft depth.

The SGLS log also detected $^{137}$Cs between 227 and 234 ft, with a maximum concentration of about 3.2 pCi/g at 229 ft. Traces of $^{137}$Cs were also detected intermittently between 243 and 251 ft. The source of this contamination is not known. Other boreholes in the vicinity also exhibit similar contamination profiles at approximately the same elevation. This contamination may have been deposited on the casing from groundwater contaminant plumes in the past when groundwater levels were higher.

## References:

Additon, M.K., K.R. Fecht, T.L. Jones, and G.V. Last, 1978. *Scintillation Probe Profiles From 200 East Area Crib Monitoring Well*s, RHO-LD-28, Rockwell Hanford Operations, Richland, Washington.

Chamness, M.A., and J.K. Merz, 1993. *Hanford Wells*, PNL-8800, Pacific Northwest Laboratory, Richland, Washington.

Ledgerwood, R.K., 1993. *Summaries of Well Construction Data and Field Observations for Existing 200-East Resource Protection Wells*, WHC-SD-ER-TI-007, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

[1] GWL – groundwater level
[2] TOC – top of casing
[3] HWIS – Hanford Well Information System
[4] N/A – not applicable

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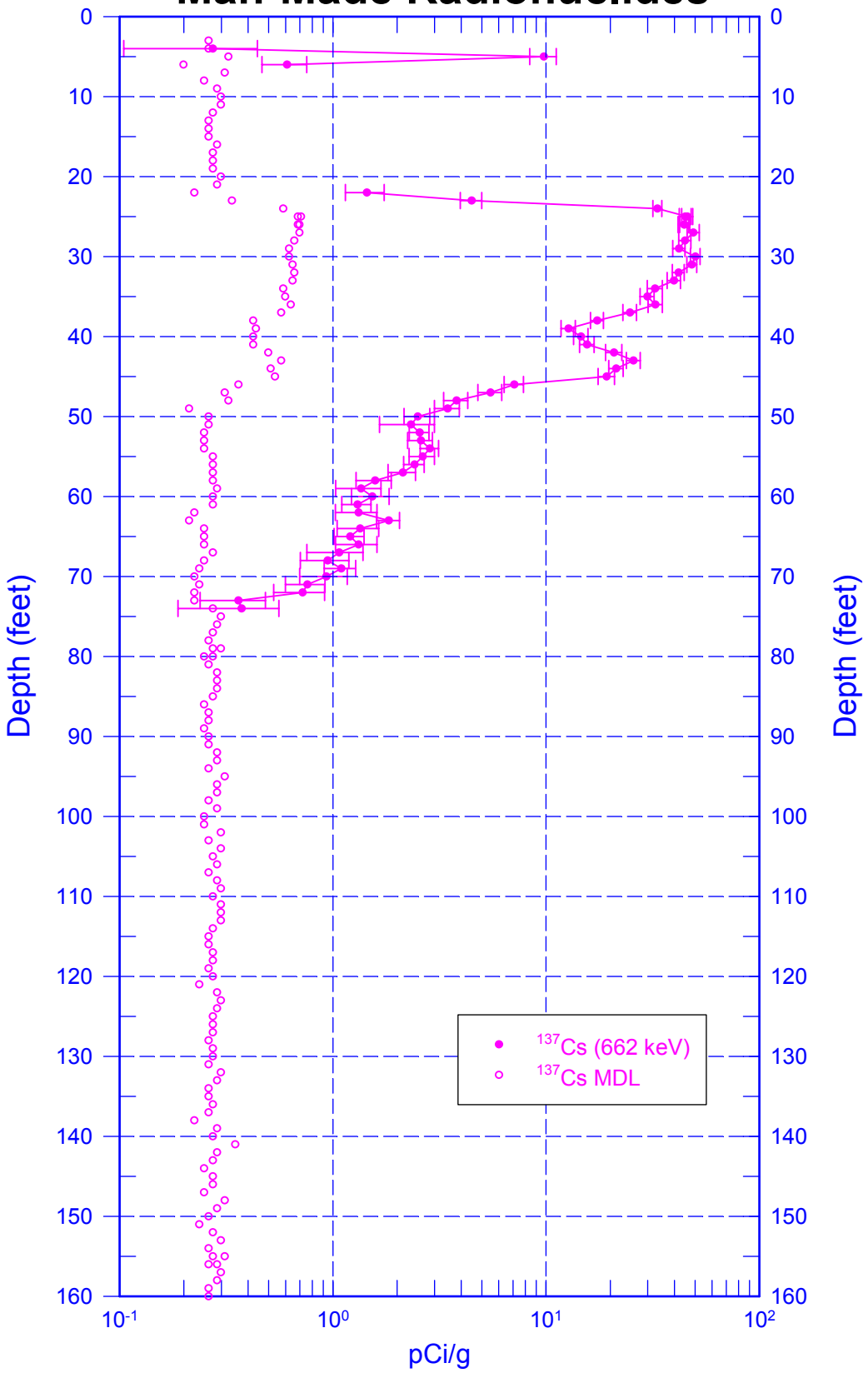
## Man-Made Radionuclides




Zero Reference = Top of Casing

Date of Last Logging Run
7/08/2004

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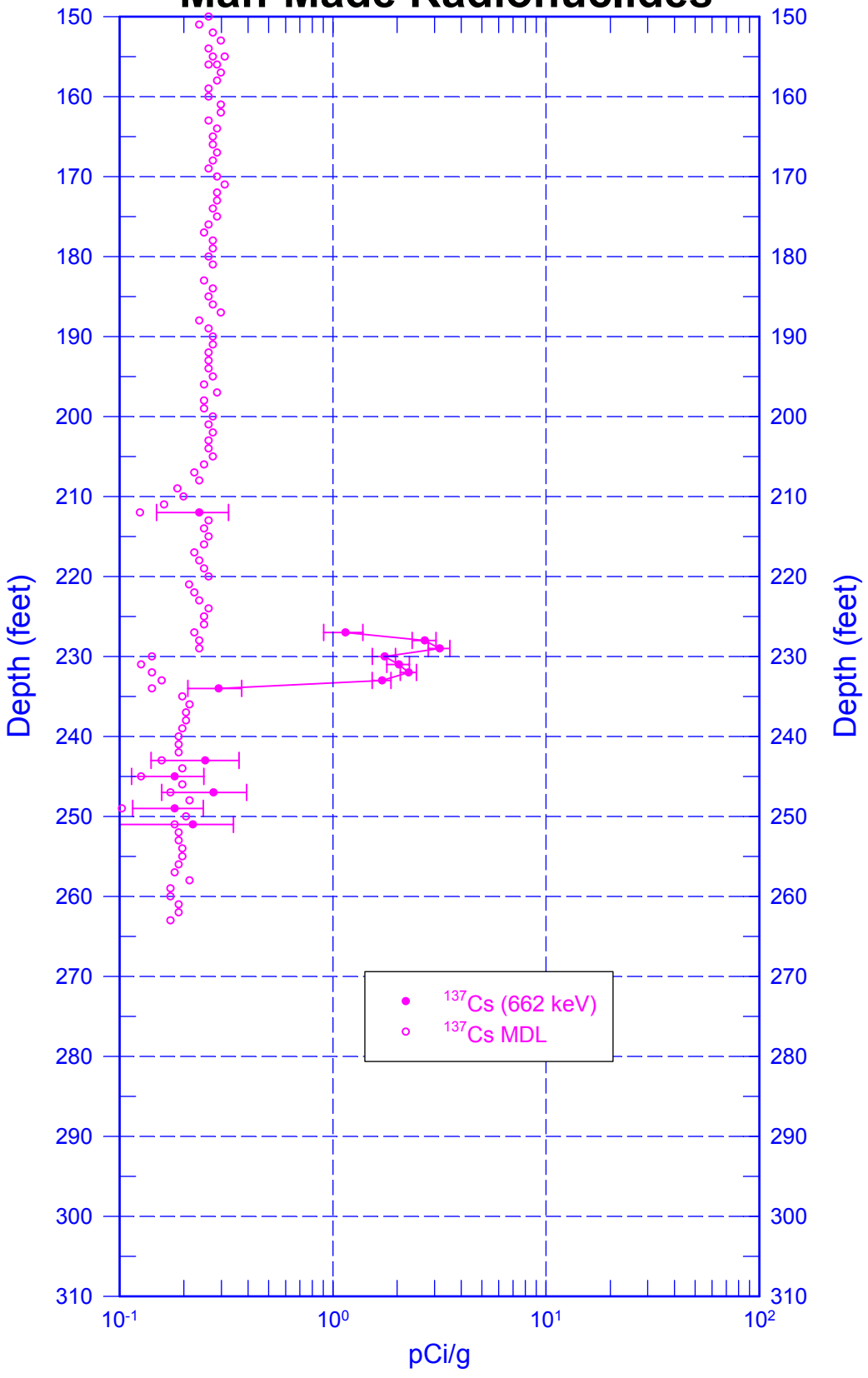
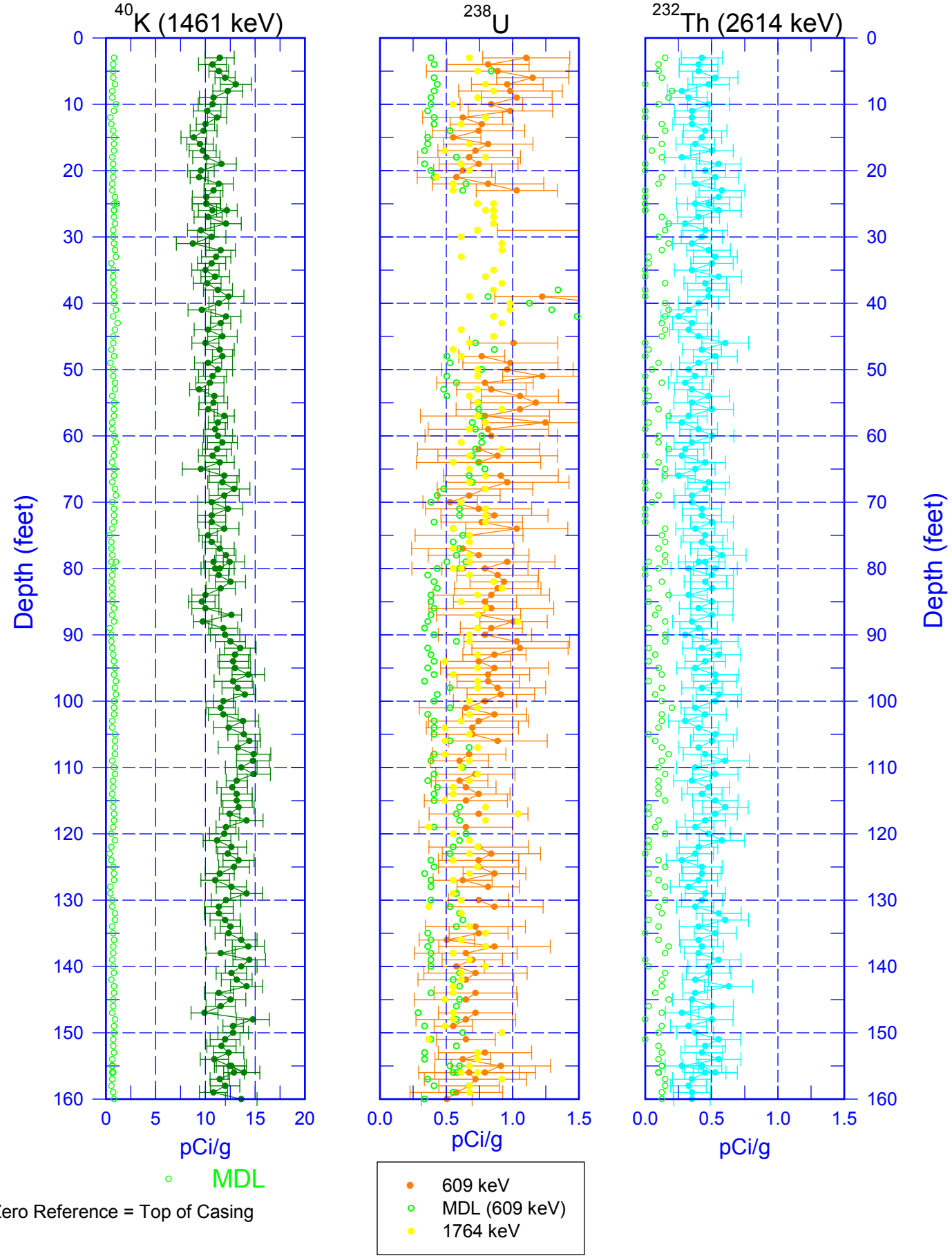
## Man-Made Radionuclides




Zero Reference = Top of Casing

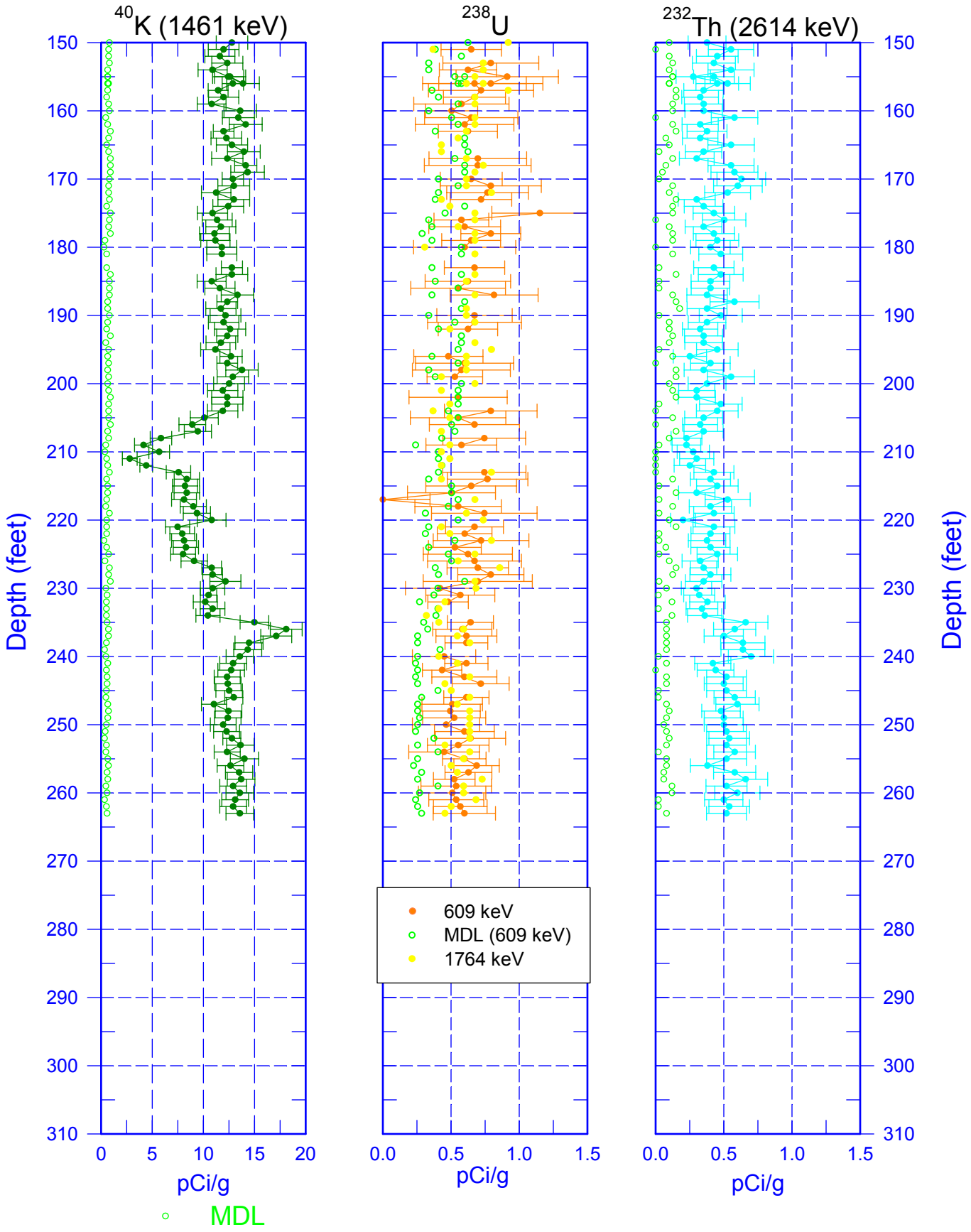
Date of Last Logging Run
7/08/2004

# 299-E25-6 (A4796)
## Natural Gamma Logs



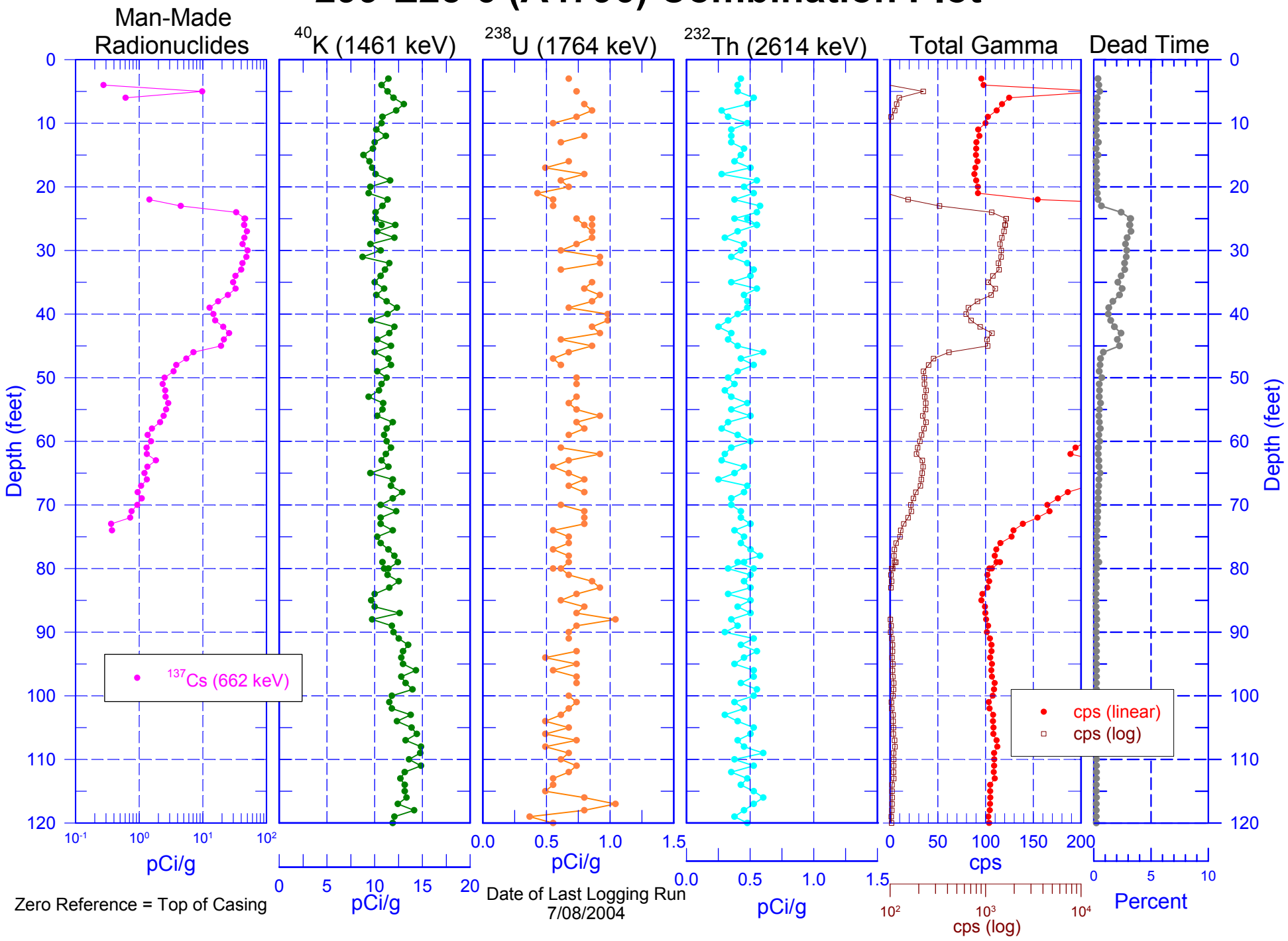

Zero Reference = Top of Casing

# 299-E25-6 (A4796)
## Natural Gamma Logs

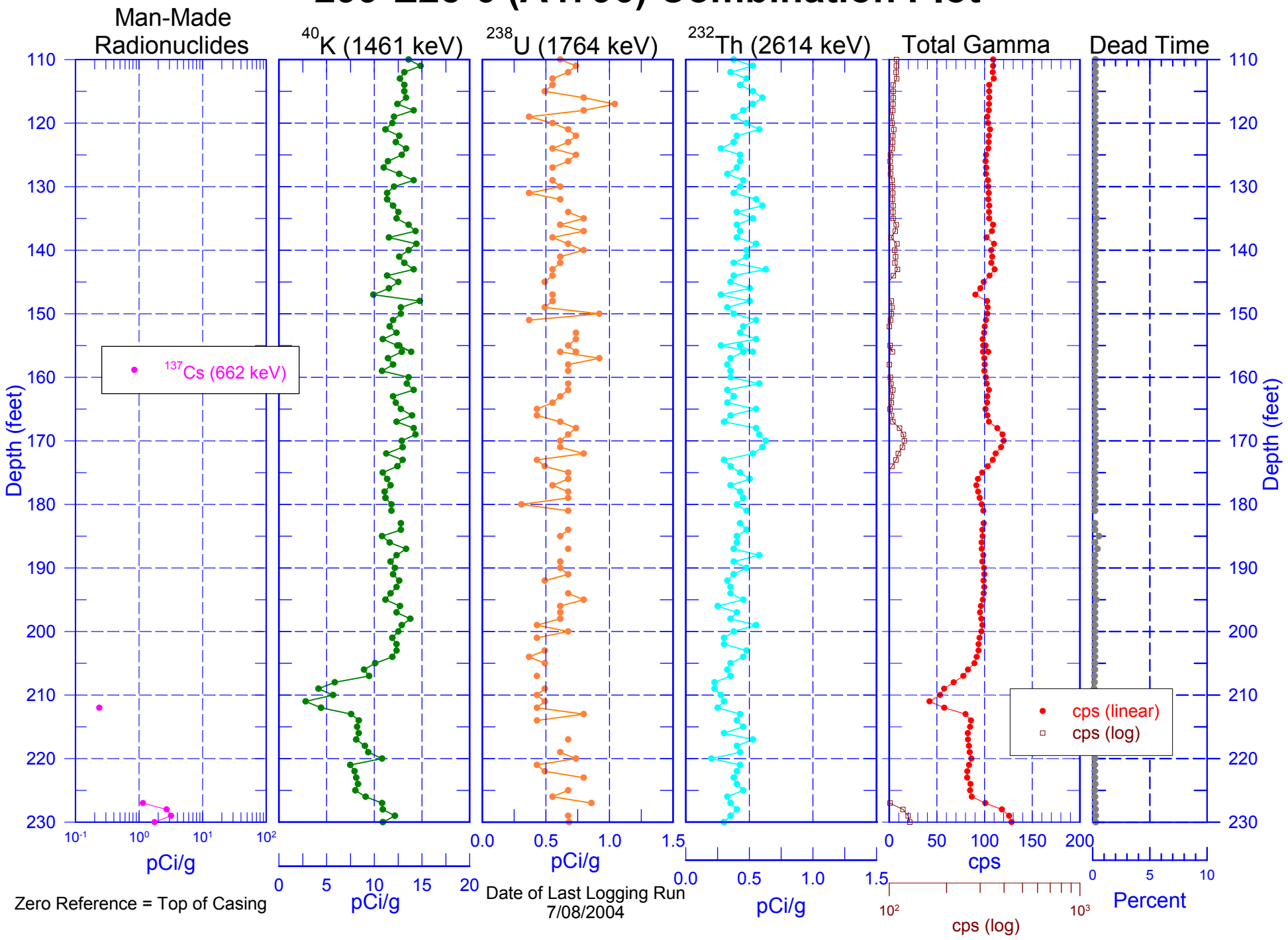



Zero Reference = Top of Casing

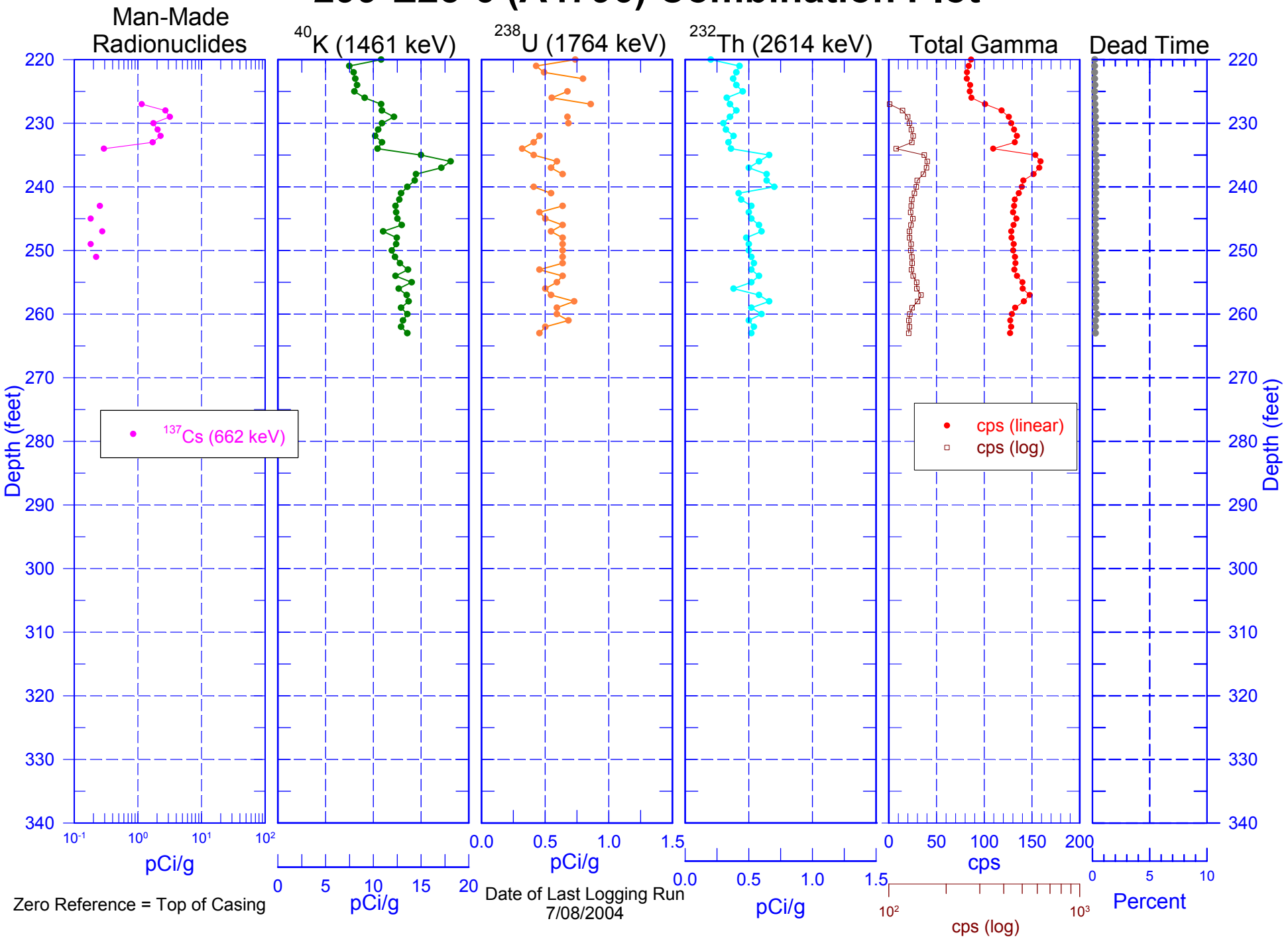
# 299-E25-6 (A4796) Combination Plot



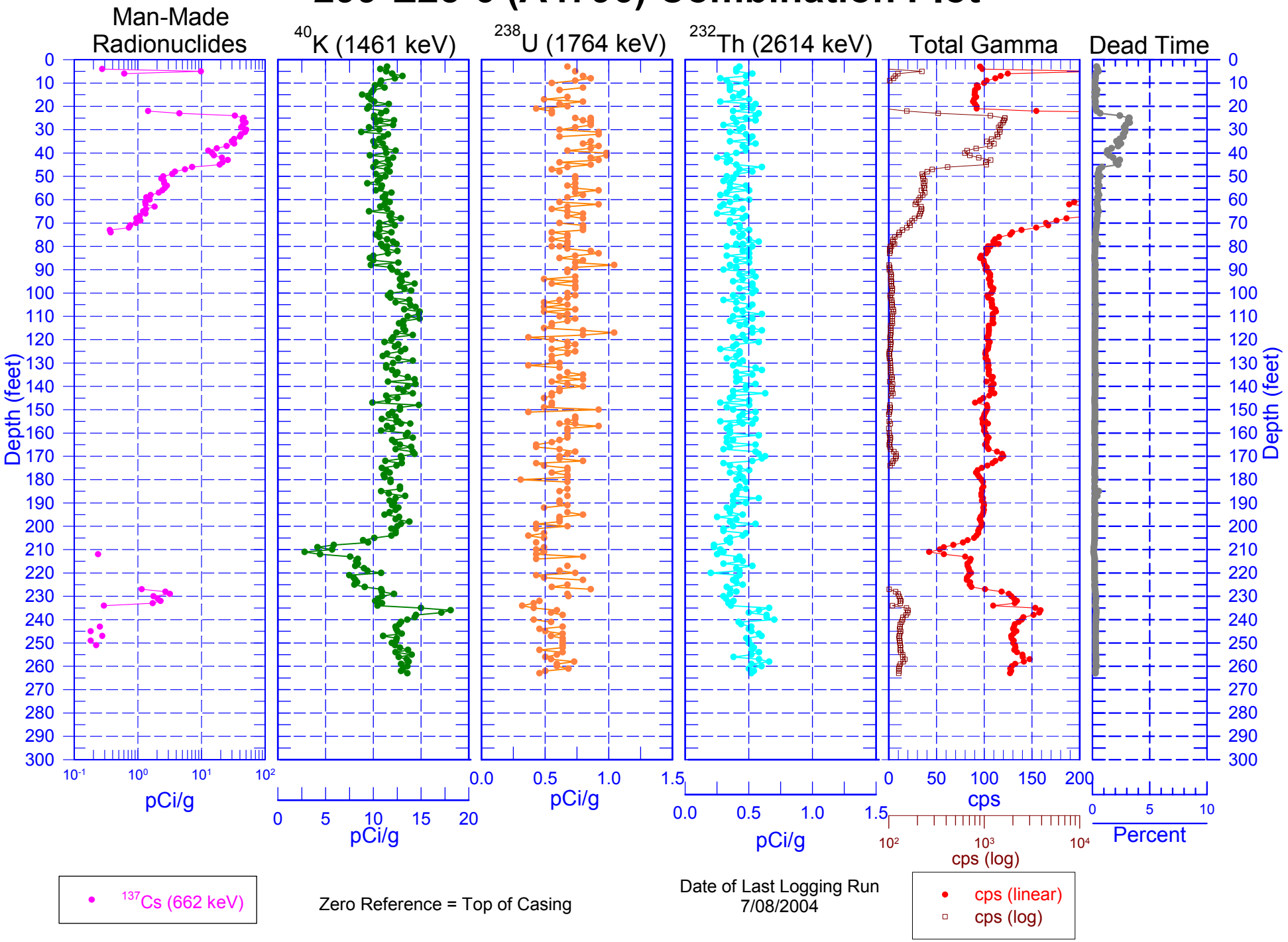
# 299-E25-6 (A4796) Combination Plot



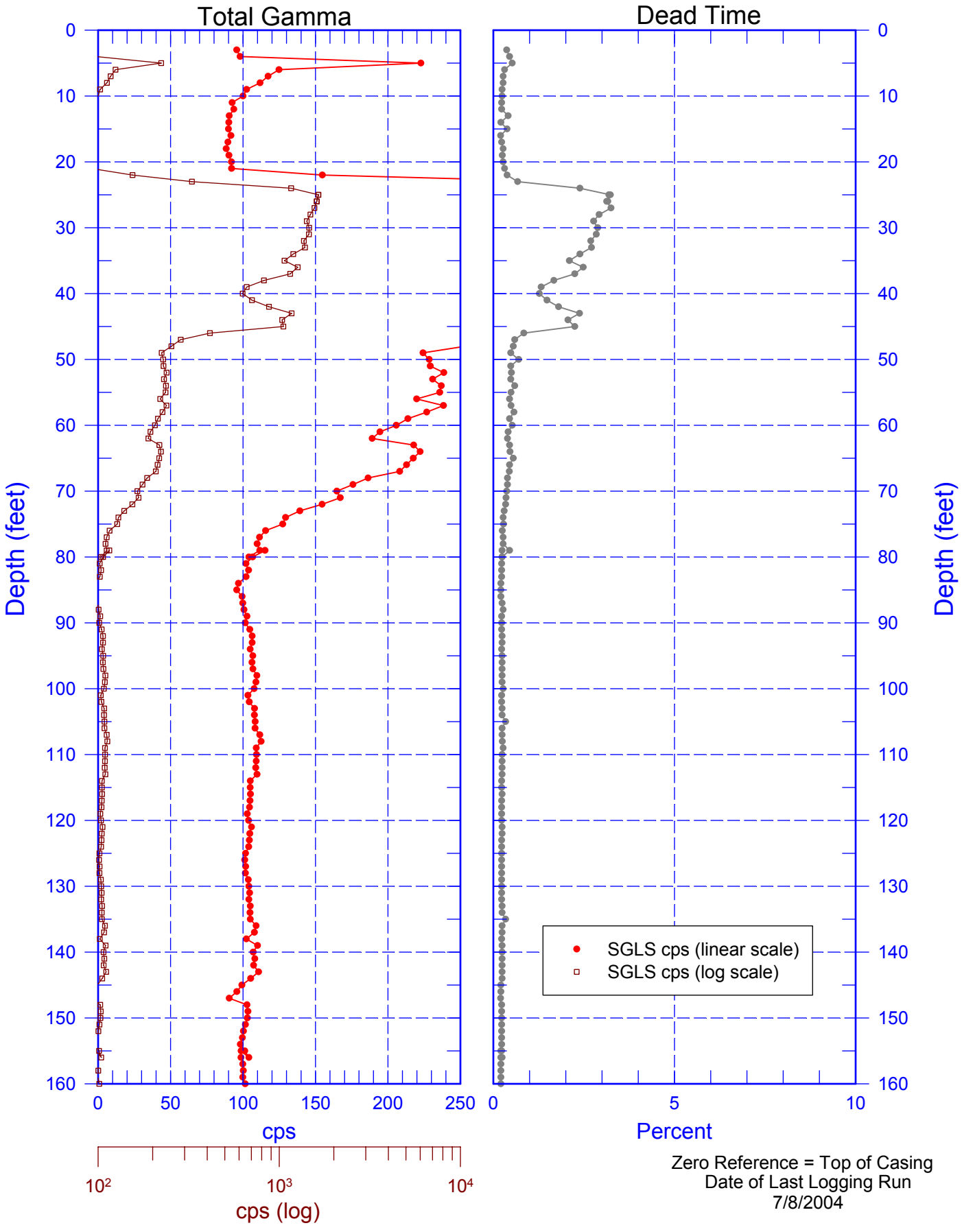
# 299-E25-6 (A4796) Combination Plot



# 299-E25-6 (A4796) Combination Plot



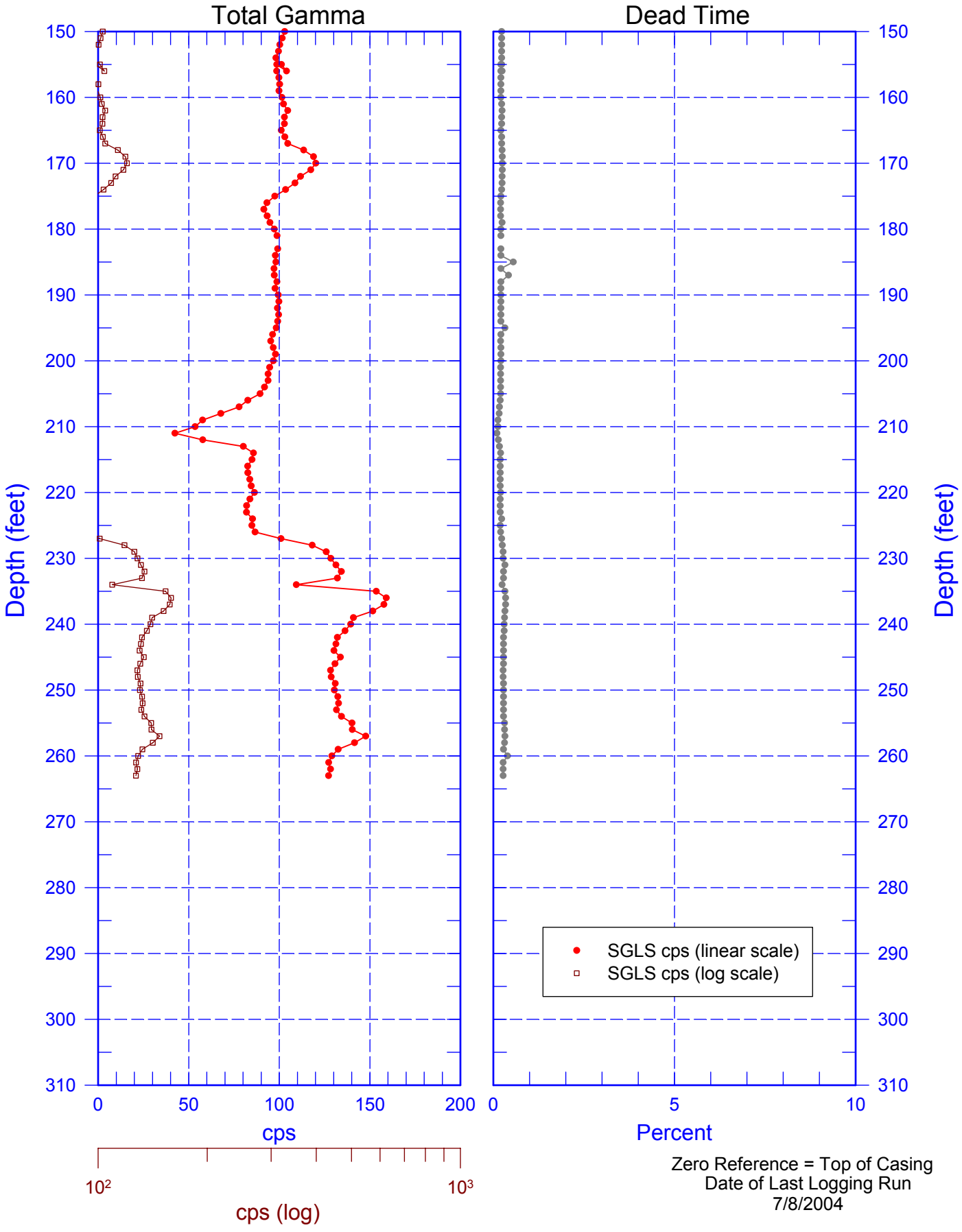
# 299-E25-6 (A4796)
## Total Gamma & Dead Time




Zero Reference = Top of Casing
Date of Last Logging Run
7/8/2004

# 299-E25-6 (A4796)

## Total Gamma & Dead Time




Zero Reference = Top of Casing
Date of Last Logging Run
7/8/2004

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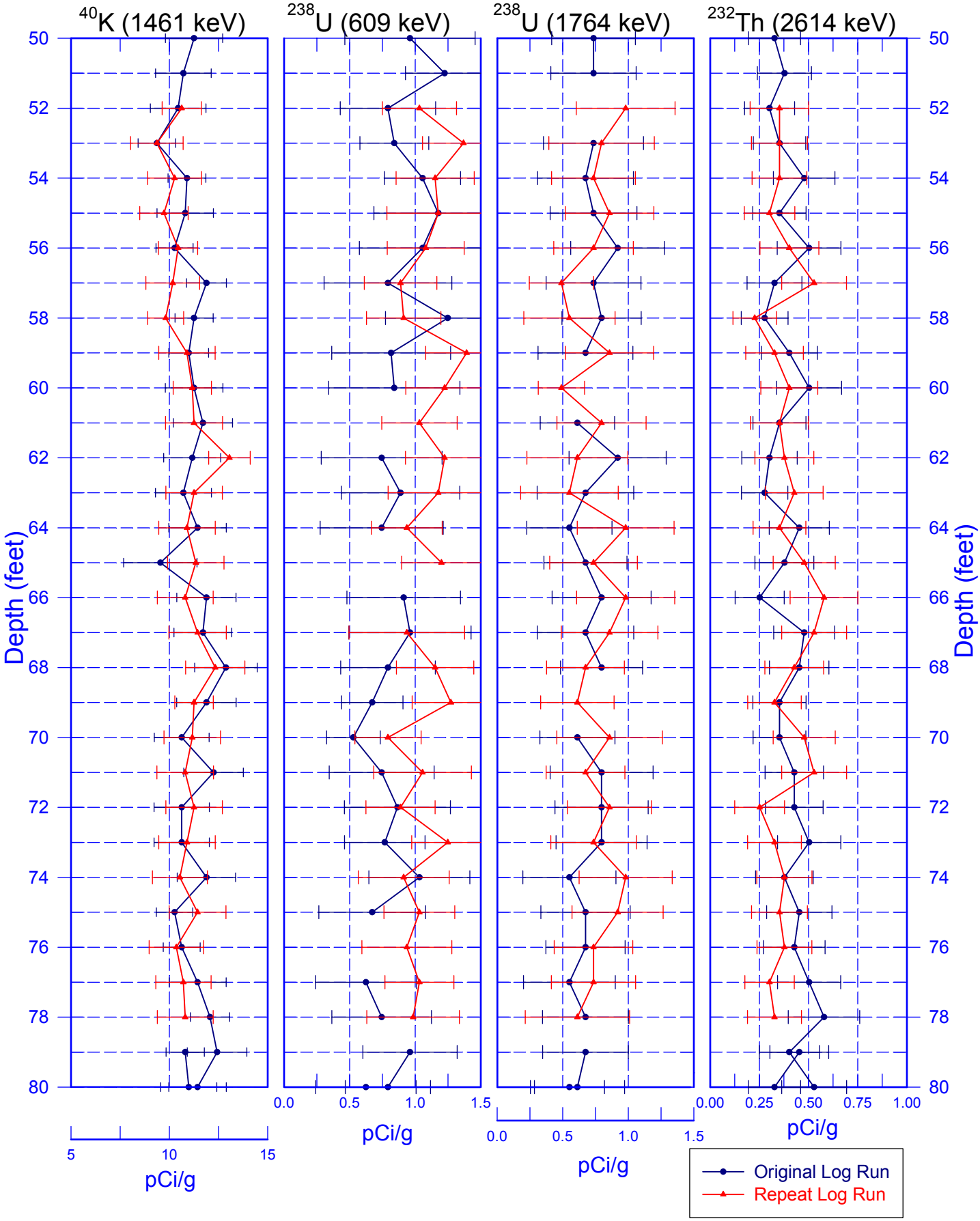
## Rerun of Natural Gamma Logs (52.0 to 78.0 ft)



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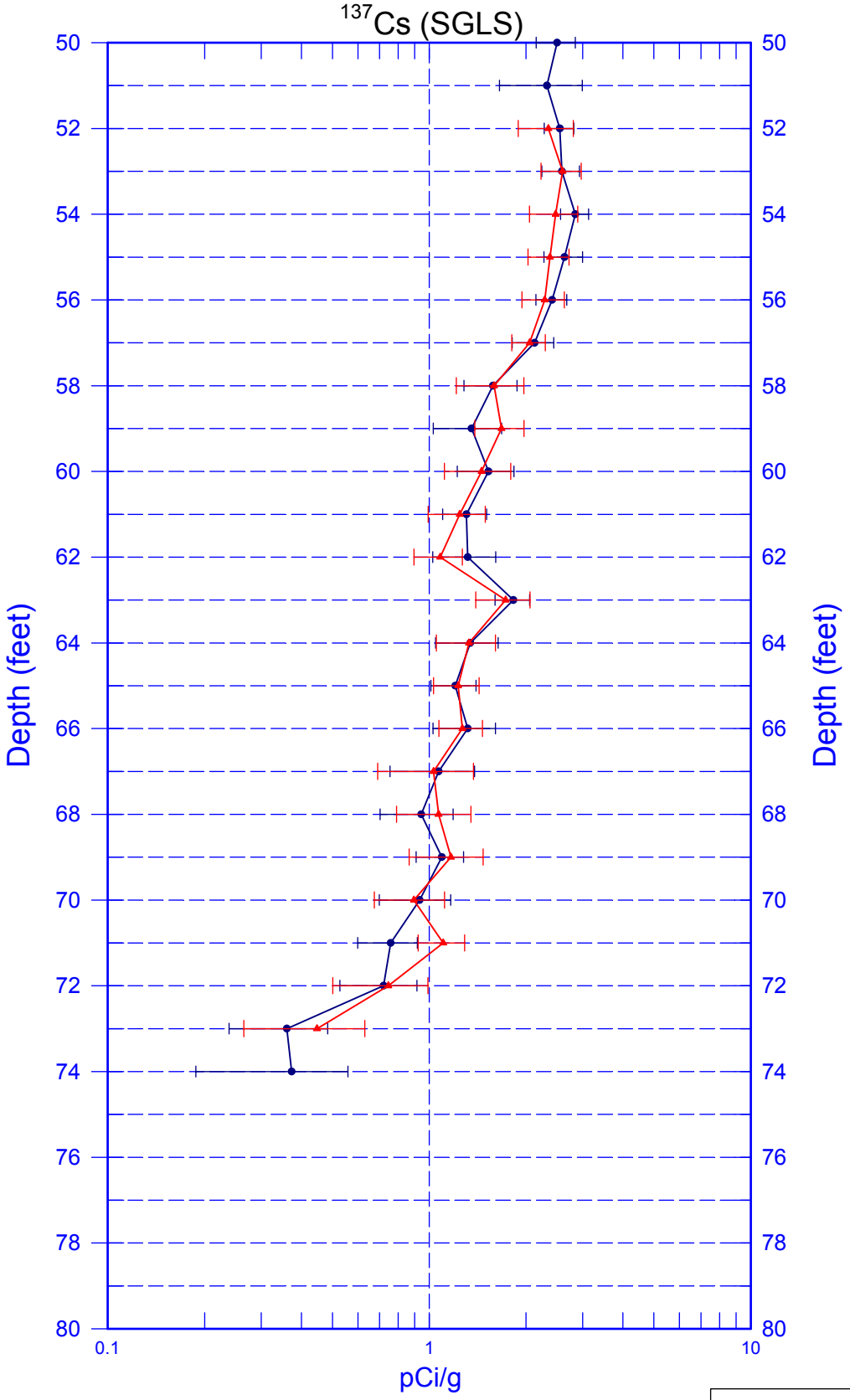
## Rerun of $^{137}Cs$



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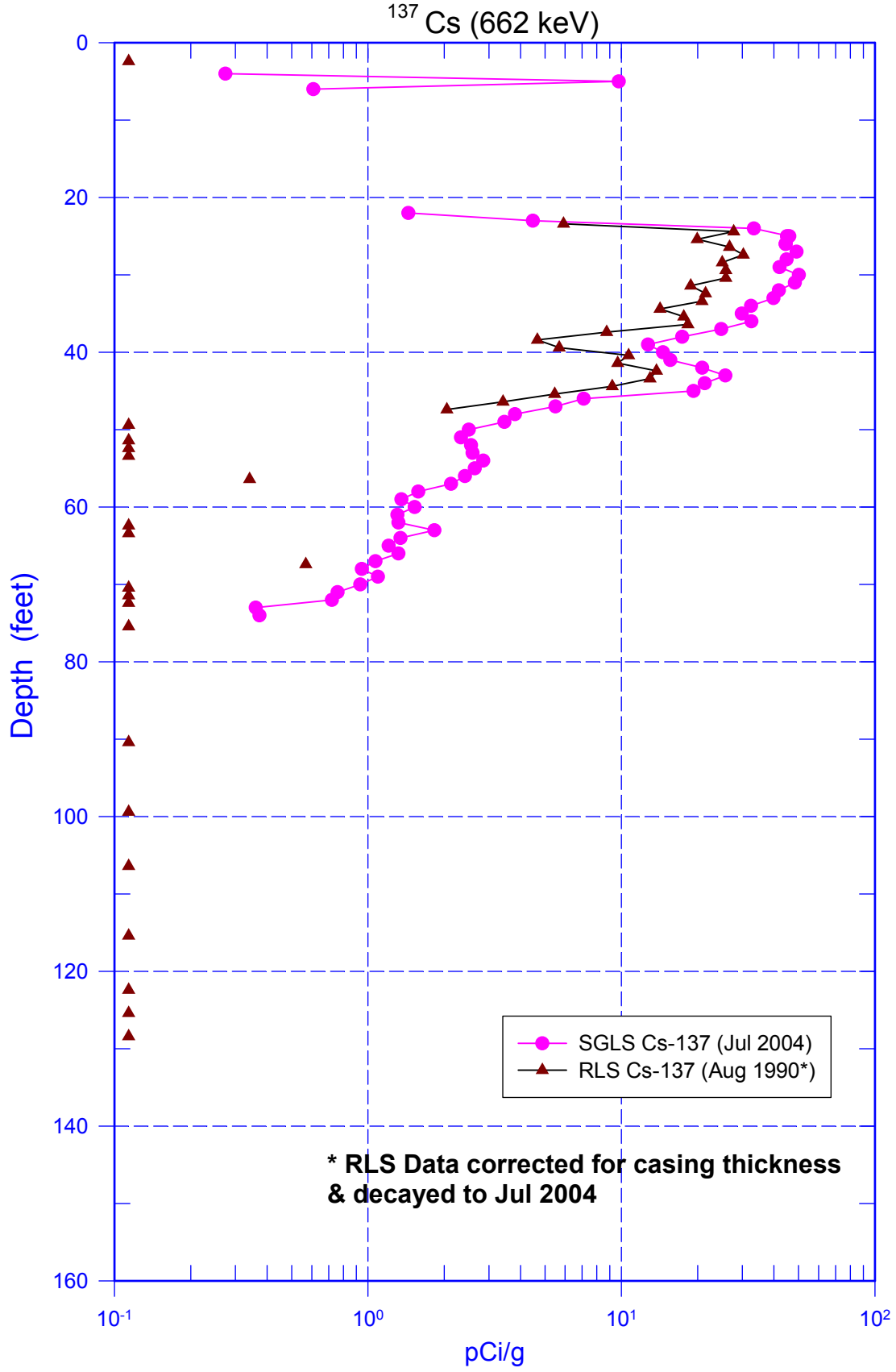
## Man-Made Radionuclide Concentrations

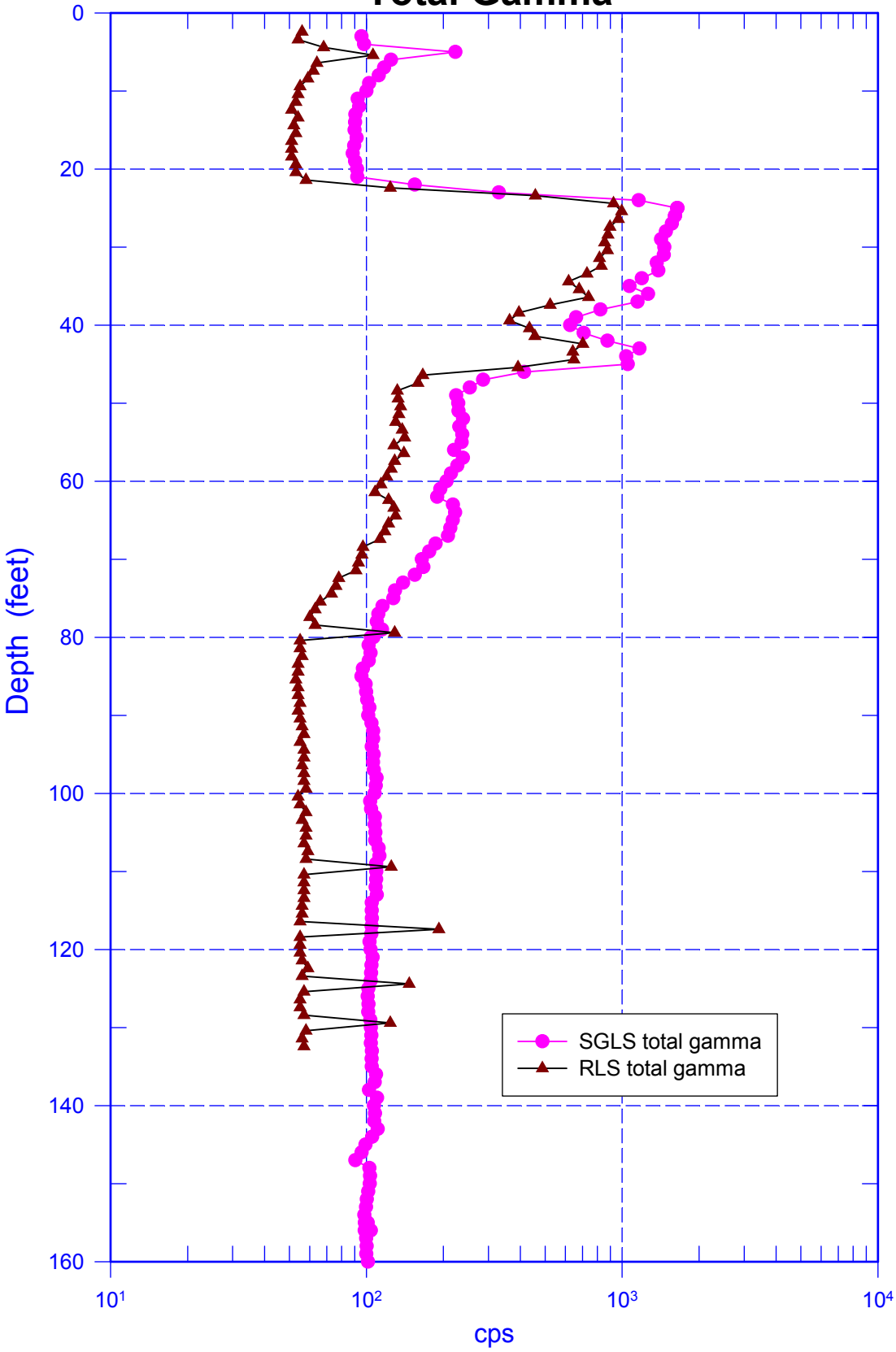



Logged August 30, 1990

Zero Reference = Top of 6" casing

# 299-E25-6 (A4796)

## Total Gamma

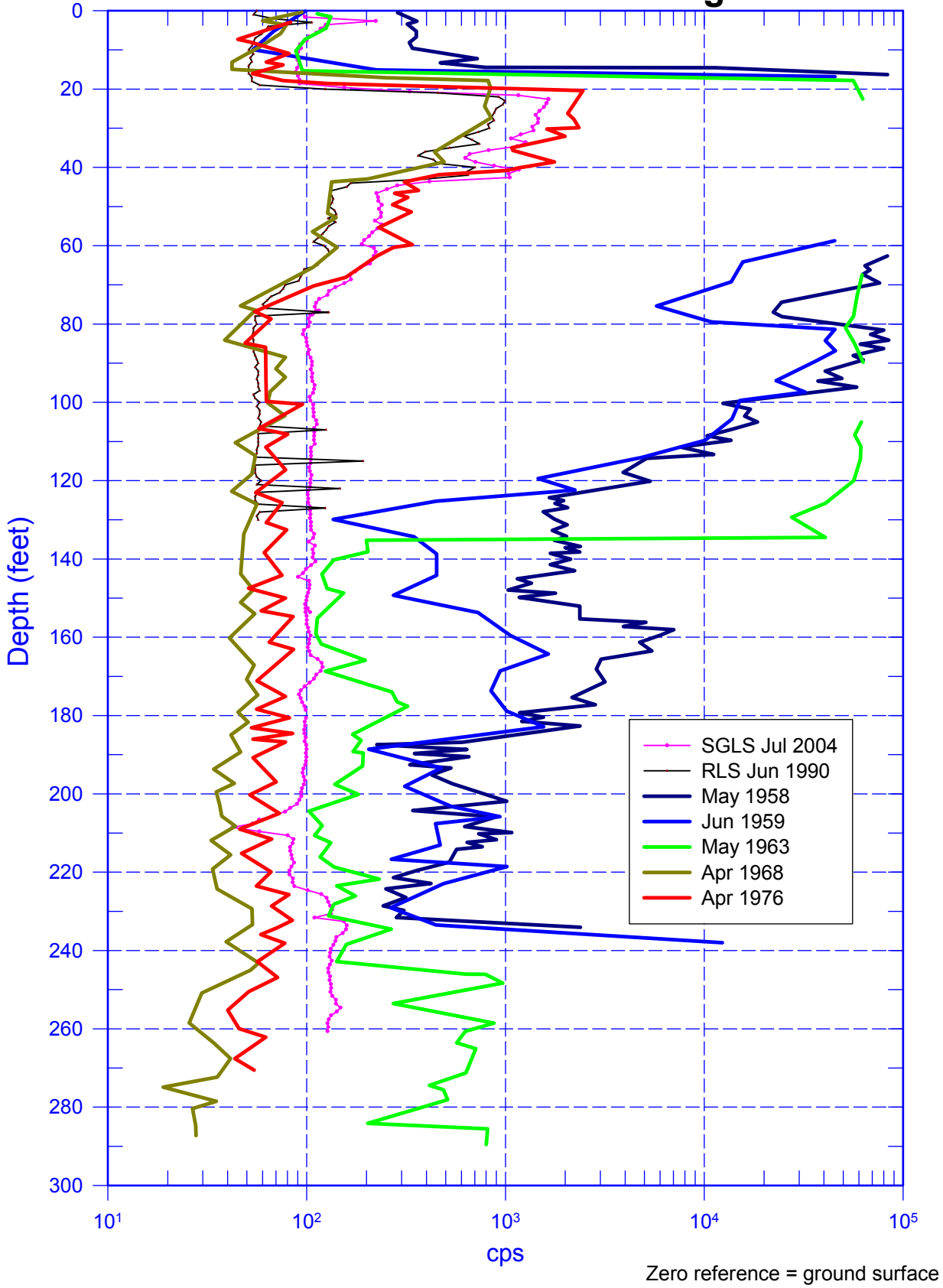



Logged August 30, 1990

Zero Reference = Top of 6" casing

# 299-E25-6 (A4796)

## Comparison of Historical and Current Total Gamma Logs




Zero reference = ground surface